

Keywords: Cardiac output; Non-invasive measurement; Cardiac rehabilitation

Objectives.— To evaluate the feasibility at rest with reproducibility of the intra-operator and inter-operator measurement of CO and to compare with measurements obtained by transthoracic echocardiography (TTE). To estimate the feasibility during effort and during the recovery effort. To determine the diagnostic, therapeutic and prospective implication.

Methods.— Observational study based on 142 consecutive outpatients included from cardiac rehabilitation (CHU Dijon). IGR was performed before and/or during and/or after the cardiac stress test by photoacoustic analysis using two inert gases: 0.5% nitrous oxide and 0.1% sulfur hexafluoride (indirect oxygen Fick Method - Innocor®). Statistical analysis based on correlation analysis, Bland and Altman, and standardization.

Results.— At rest, the correlation coefficient was 0.91 ($P < 0.001$) between two CO in intra-operator in 26 patients, 0.89 ($P < 0.001$) between two CO in inter-operator in 30 patients, 0.38 ($P = 0.039$) between the CO measured by IGR and TTE in 30 patients. Using the method of Bland and Altman, the range of variation of repeatability was respectively $\pm 27\%$, $\pm 33\% \pm 42\%$. During the effort in 45 patients, formulas of standardization were used to assess components: stroke volume (SV) and heart rate (HR). Two populations were isolated: preferential increase in SV or HR.

Conclusion.— At rest, feasibility, repeatability and reproducibility of the measurements are correct (despite the dispersion related to measurement of CO). At submaximal exercise, feasibility is good. The measurement to quantify the hemodynamic changes during rehabilitation is valid and applicable in various pathological conditions (heart failure in high CO at rest, etc), and could help to adapt the use of chronotropic drug.

References

- [1] Goda A et al. Usefulness of non-invasive measurement of cardiac output during sub-maximal exercise to predict outcome in patients with chronic heart failure. *AM J Cardiol* 2009; 104(Suppl. 11):1556–60.
- [2] Follath F. Challenging the dogma of high target doses in the treatment of heart failure: is more always better? *Arch Cardiovasc Dis* 2009;102:785–9.

doi:10.1016/j.rehab.2011.07.531

CO18-007–EN

Long-term lifestyle intervention and optimized high intensity interval training program improve body composition, cardiovascular risk and exercise capacity in obese patients with or without metabolic syndrome

J. Drigny^{a,*}, M. Gayda^b, A. Nigam^c, V. Guilbeault^c, M. Juneau^c, V. Gremeaux^d

^a Institut de cardiologie de Montréal, centre de prévention et d'activités physiques (centre ÉPIC), 5055, rue St-Zotique Est, H1T 1N6 Montréal, Québec Canada

^b Centre de prévention et d'activités physiques de l'institut de cardiologie de Montréal (centre ÉPIC; département de Kinésiologie, université de Montréal, Canada

^c Centre de prévention et d'activités physiques de l'institut de cardiologie de Montréal (centre ÉPIC), Montréal, Canada

^d Centre de prévention et d'activités physiques de l'institut de cardiologie de Montréal (centre ÉPIC), pôle rééducation-réadaptation, CHU Dijon, France

*Corresponding author.

Keywords: Obesity; Metabolic syndrome; Exercise; Interval training; Cardiovascular risk

Purpose.— To study long-term effects of lifestyle intervention and exercise program including optimized high-intensity interval exercise training (HIIT) and resistance training performed 2 to 3 times/week, on body composition, cardiometabolic risk factors, cardiovascular risk and exercise tolerance in obese subjects with or without metabolic syndrome.

Methods.— Sixty-two obese subjects (53.3 ± 9.7 years, BMI: $35.8 \pm 5 \text{ kg/m}^2$), 37 of whom with metabolic syndrome (MetS), were retrospectively identified at their entry into the program. Anthropometric measurements, cardiometabolic

and after 9 months of program.

Results.— No adverse events were noted during HIIT training. Weekly energy expenditure was in line with recommendations ($1582 \pm 284 \text{ kcal}$). Significant and clinically relevant improvements were found for body mass ($-5.3 \pm 5.2 \text{ kg}$, $P < 0.0001$), BMI ($-1.9 \pm 1.9 \text{ kg.m}^{-2}$, $P < 0.0001$), waist circumference ($-5.8 \pm 5.4 \text{ cm}$, $P < 0.0001$), and maximal exercise capacity ($+1.26 \pm 0.84 \text{ METs}$, $P < 0.0001$). Total fat mass and trunk fat mass ($P < 0.0001$), lipid profile, insulin sensitivity ($P < 0.0001$) and Framingham scores ($P < 0.05$) were also significantly improved. At the end of the program, 32.5% of MetS subjects no longer possessed MetS diagnostic criteria ($P < 0.05$). Independent predictor of being a responder to body mass and waist circumference (WC) decrease were baseline BMI and resting metabolic rate, as well as smoking status for WC, and baseline WC and triglycerides/HDL-cholesterol ratio for BMI decrease.

Conclusion.— Long-term lifestyle intervention associated with optimized HIIT improve body composition, cardiometabolic risk factors, cardiovascular risk, MetS prevalence and exercise tolerance in obese subjects. This intervention appeared safe, efficient, well tolerated and could improve adherence to exercise training programs in this population.

doi:10.1016/j.rehab.2011.07.532

CO18-008–EN

High-intensity interval training program improves body composition, exercise capacity and metabolic profile better than moderate-intensity continuous exercise in MetS patients with similar effects on ventricular repolarisation parameters

J. Drigny^{a,*}, T. Guiraud^b, M. Gayda^c, M. Juneau^c, A. Nigam^c, V. Gremeaux^d

^a Institut de cardiologie de Montréal, Québec Canada

^b Clinique de rééducation cardiovasculaire et pulmonaire de Saint-Orens, Saint-Orens de Gameville, Canada

^c Centre de prévention et d'activités physiques de l'institut de cardiologie de Montréal (centre ÉPIC), Montréal Canada

^d Centre de prévention et d'activités physiques de l'institut de cardiologie de Montréal (centre ÉPIC), pôle rééducation-réadaptation, CHU de Dijon, 5055, rue St-Zotique Est H1T 1N6 Montréal, Québec Canada

*Corresponding author.

Keywords: Metabolic syndrome; Exercise; Interval-training; Ventricular repolarisation; Arrhythmia

Purpose.— To compare the long-term effects of two different modes of exercise training (moderate intensity continuous exercise [MICE] vs. high-intensity interval training [HIIT]) on QT dispersion (QTd) parameters (a marker of myocardial electrical instability), cardiovascular risk factors, and exercise capacity in patients with metabolic syndrome (MetS).

Methods.— Sixty-five MetS patients (mean age: 53 ± 9 years) were assigned to either a MICE (30 minutes at an intensity corresponding to 60% of peak power output, $n = 30$) or a HIIT exercise prescription (two sets of 10 minutes of repeated bouts of 15 and/or 30 sec at 80% of peak power output interspersed by 15 and/or 30 sec phases of passive recovery, $n = 35$) on a cyclergometer. Exercise training was performed 3 times/week during 9 months. Ventricular repolarization parameters (QT dispersion = QTd, standard deviation of QT = SDQT, relative dispersion of QT = RDQT, QT corrected dispersion = QTcd), cardiometabolic risk factors, anthropometric data and maximal exercise capacity were assessed at baseline and after the 9 months training period.

Results.— No adverse events were noted during HIIT training. QTd decreased significantly in both groups (QTd pre vs. post = 50 vs. 44 ms in MICE group, $P < 0.0001$; 38 vs. 34 ms in HIIT group, $P < 0.01$). Other ventricular repolarization parameters also improved significantly in both groups. Exercise capacity significantly increased ($+0.9$ and $+1.2 \text{ METs}$ ($P < 0.0001$) in MICE and HIIT group, respectively), as well as lipid profile. Changes in QTd were correlated with changes in METs ($r = -0.21$, $P < 0.03$), triglycerides level ($r = 0.27$, $P < 0.02$) and triglycerides/HDL-cholesterol ratio ($r = 0.21$, $P < 0.03$) for HIIT group only. No

associations were identified for MICE group. When compared to MICE, HIIT induced a significantly higher decrease in weight (-4.85 vs. -2.1 kg, $P < 0.05$), body mass index (-1.72 vs. -0.81 kg/m²), and waist circumference (-5.4 vs. -0.5 cm, $P < 0.05$).

Conclusion.— Long-term HIIT exercise training program safely led to greater improvements in body composition than MICE, with similar effects on ventricular repolarization parameters, in MetS patients. Our results suggest that improvements in QTd parameters observed are primarily induced by exercise training, whatever the type, rather than by improvement in body composition and metabolic profile.

doi:10.1016/j.rehab.2011.07.533

CO18-009-EN

Acute inhibitory effect of neuromuscular electro stimulation on muscle sympathetic activity in chronic heart failure

V. Lambert^{a,*}, P. Marque^a, A. Pathak^b, M. Labrunee^c

^a Service de MPR, CHU Toulouse, 1, avenue J Poulhès, 31059 Toulouse, France

^b Service de Cardiologie, CHU Toulouse, Inserm U1048 Equipe 8, Toulouse, France

^c Service de MPR- CHU Toulouse, Inserm U1048 Equipe 8, Toulouse, France

*Corresponding author.

Keywords: Neuromuscular electro stimulation; Chronic Heart Failure; MSNA

Introduction.—Chronic Heart Failure (CHF) is associated with Sympathetic Overactivity (SO) characterized by increase of Muscle Sympathetic Nerve Activity (MSNA). SO is often a target for pharmacologic or non-pharmacologic treatment in CHF. Experimental and clinical data suggest a beneficial effect of NMES in CHF. However, the impact of NEMS on sympathetic activity has to our knowledge never been investigated before [1].

Objective.— Investigate the immediate effect of one session of NMES on sympathetic activity as assessed directly by MSNA.

Method.— We performed a randomized, double blinded cross over sham controlled study in 11 CHF patients (mean ejection fraction $24\% \pm 6$, age = 62.7 ± 3.6 years, NYHA = 3/4 (82%/18%). The sham group were patients receiving the device set up to induce to an electrical painless stimulation without muscle contraction. Electromyostimulation (both efficient and placebo) were performed randomly during 5 minutes. Blood pressure, heart rate, respiratory rate and MSNA were recorded just after both sessions.

Results.— EMS induced a significant decrease in MSNA (-9.5% , $P = 0.0039$). This decrease was not associated with modification of hemodynamic and respiratory parameters. After placebo stimulation there was no alteration of parameters.

Conclusion.— We show for the first time that acute EMS decreases high sympathetic nerve activity in patients with CHF. This effect could explain beneficial use of NMES in CHF in parallel with other known actions of this treatment [2].

References
[1] Casillas JM, Gremaux V, Labrunee M, et al. Low-frequency electromyostimulation and chronic heart failure. *Ann Readapt Med Phys* 2008;51(Suppl. 6):461–72.

[2] Nuhr MJ, Pette D, Berger R, et al. Beneficial effects of chronic low-frequency stimulation of thigh muscles in patients with advanced chronic heart failure. *Eur Heart J* 2004;25(Suppl. 2):136–43.

doi:10.1016/j.rehab.2011.07.534

CO18-010-EN

Muscle oxygenation in Becker muscular dystrophy evaluated by near infrared spectroscopy

E. Allart^{a,*}, N. Olivier^b, V. Wiczorek^c, H. Hovart^c, A. Thevenon^c, V. Tiffreau^c

^a Service de médecine physique et de réadaptation, CHRU de Lille, rue André-Verhaeghe, 59037 Lille cedex, France

^b Laboratoire « Activité physique, muscle, santé » EA4488, faculté des sports, université Lille 2, Ronchin France

^c Service de MPR, hôpital Swynghedauw, CHRU de Lille, France

*Corresponding author.

Keywords: Dystrophin; Becker muscular dystrophy; Muscle oxygenation; NIRS; Exercise therapy; Neuromuscular diseases; NO

Objectives.— To determine modifications of muscle oxygenation during effort in patients with Becker Muscular Dystrophy (BMD) and its links with global tolerance of effort and functional status.

Patients and method.— Ten patients affected by BMD (32 ± 12 years) and 10 age-paired controls performed two isokinetic constant load sessions of exercises of the knee in a concentric (extension)/passive (flexion) configuration. The first session was set at 20% of extensors maximal peak torque (same relative load), the second session was set at the same absolute load of 20 N. Muscle oxygenation was evaluated non-invasively using NIRS. Deoxyhaemoglobin signal was considered for oxygenation criteria. Heart rate, subjective fatigue (Borg scale) and myalgias were also evaluated during effort. Finally, patient's functional status was assessed, through the MFM scale, the 6-minute walk test and the gait pattern assessment with the GAITRITE device.

Results.— BMD patients had lower peak torque (-62%) and endurance (-30%) than controls, and they were more painful ($P < 0.001$). Initial muscular deoxygenation occurred earlier at the onset of both exercises in BMD group ($P = 0.034$ and $P = 0.004$), mainly in its first part (time delay TD). There was no difference between BMD patients and controls concerning maximal deoxygenation, and no link between this one and other effort variables. We found a correlation between walking endurance and muscle oxygenation kinetics pattern.

Discussion.— The earlier deoxygenation could be explained by a decreased vasodilatation of small arteries at the onset of the effort. Indeed, NO production is decreased in BMD patients since dystrophine plays a role in NO synthase activity. Exercise therapy, which is now fully validated in neuromuscular diseases, could improve vasodilatation during effort and so decrease oxidative stress. NIRS could be a useful tool to assess exercise efficiency. Finally, links between oxygenation indexes and the other assessment tools have to be more clearly investigated, but initial deoxygenation seems to be linked to endurance.

doi:10.1016/j.rehab.2011.07.535

CO18-011-EN

Rate of recurrence of plantar ulcer after wearing therapeutic footwear: 54 patients with diabetic Charcot foot

G. Ha Van

CRF Les trois soleils, Boissise le roi, MPR, 19, rue du château, 77310 Boissise le roi, France

Keywords: Charcot foot; Diabetes mellitus; Therapeutic footwear

Objective.— To measure prospectively the rate of recurrence of plantar ulcer of 54 diabetic patients with Charcot foot after treatment with therapeutic footwear made with a multidisciplinary team.

Patients and methods.— Fifty-four diabetic patients with one or two Charcot feet with major deformation and history of plantar ulcer were treated by therapeutic footwear made by the same shoe maker. We studied prospectively the rate of recurrence of ulcer.

Results.— Eighty-five percent of 54 patients had a history of plantar ulcer which healed in 241 days. Average demographic data were average age = 58 years, diabetes age: 28 years, BMI: 28, 98% type 2, 23 right feet, 21 left feet, ten bilateral. Ninety-two percent midfoot deformation. After therapeutic footwear with a follow-up of 882 days: 2% deceased, 2% major amputation, 2% toe amputation and 91% absence of recurrence of plantar ulcer. Time of wearing shoes = 7 hours/day.

Conclusion.—Therapeutic footwear made by a specialized team allows to avoid recurrence of plantar ulcer of diabetic Charcot foot and avoid corrective surgery with the risk of complications.

doi:10.1016/j.rehab.2011.07.536